October 30, 2015

1. What are some techniques you use to build confidence in students?

2. How do you guide a student from the incorrect answer to the correct answer without explicitly telling them that they have an incorrect answer?

1) This is a good question... it's probably one of the few things I do that isn't somehow grounded in research or "best practices" because I haven't really found any thing that explicitely addresses confidence (but I also haven't looked very hard).

Confidence in mathematical process or concept comes from our ability to ground our reasoning in something external or third-party. My feeling is: most students lack confidence when their knowledge isn't firmly grounded or set, or when there isn't this external validation for what they know.

The former situation happens when students "know" something purely from arbitrary rules or tricks or a "do this because I said so" process — there's no strong glue connecting the rule to the procedure, so rules get mixed up and confused. I see this the

most with adding & subtracting integers - those "rules" get confused with the "rules" of multiplying & dividing integers. If a student is only told a rule, it won't stick.

Something I do intentionally is find some kind of structure or visual as context (something in real life) to act as their intuition, then force them to solve problems that way. Eventually, patterns will emerge and students will "notice" the "rules" for a certain process. Something I do intentionally is: I never tell a student a shortcut, but I will validate it if they can explain it to me.

~~for example: if a student had to solve $\frac{3}{4} + \frac{1}{6}$, I would have them multiply both denominators to find a common denominator of 24~~

For example: If I were teaching how to add fractions with different denominators, I would emphasize the need for a new common denominator and that this can always be achieved by multiplying both denominators to get a shared denominator. So if a student needed help solving $\frac{1}{2} + \frac{1}{6}$, I would refer them back to this intuition & process - to multiply both denominators - and end up with a common denominator of 12 that would need to be simplified. However, if a student asks if they can just multiply the left fraction by 3, I would make them explain their reasoning and, if I were satisfied, I would tell them the strategy for finding the lowest common denominator. The key here is: the student is ready to hear about an alternate strategy or "shortcut" - if I present it when they're not ready, it feels like a new rule to remember rather than an extension of an existing one. I have to be careful not to move too fast.

Anyway - those are strategies to make sure things become grounded - Find an intuition to rely on (visuals / number line / real-world context) and only show shortcuts when ready. This could also be achieved by lots of drill-and-kill, but ~~why~~ it that doesn't work for everyone and the ones that don't learn that way are the ones who end up in my classes.

There's also an affective piece to building confidence - designing moments where students can demonstrate that they know something and be complimented for their effort & perseverance and carefulness. This happens a lot with bellwork - I design problems where I can sit next to a student, guide them with questions through a problem, then reinforce that they were able to solve it correctly on their own. Sometimes all it takes is sitting next to a student as they work on a problem and, when they're done, confirming they did it correctly.

I guess the last thing that comes to mind is my insistence that students have a way to explain their answer, usually with a picture or some other math structure. It's the whole "Never Say Anything a kid Can Say" philosophy - I expect them to explain their answer completely, and once they can verbalize it to me and to each other, they can explain it to themselves when they're unsure.

So... confidence building is: positive reinforcement, high expectations for verbalizing explanations, finding ways to avoid arbitrary rules and replace them with a tangible intuition, and not moving onto "short cuts" or "extensions" until they're ready.

2) Guiding From incorrect to correct:
Good questioning, an intuition to fall back on, and never saying anything a kid can say.

There aren't a lot of situations where the First thing I do is tell a student they're incorrect (although they do happen under important circumstances). Instead, I try to parse their reasoning behind their answer. Something I do intentionally is I usually start by asking about a correct answer. In fact, this month I've just started trying "which answer are you most confident about? Tell me about that one". In their explanation, I make sure I ask all the questions that I will eventually ask for the incorrect problem. Once they've explained the correct problem, we look at the incorrect one. My goal is to create a moment of cognitive dissonance - their explanation may not match with their answer and they have to decide

if they want to stick with the explanation or with the incorrect answer they wrote. Most of the time, they'll realize their mistake and fix it. This is a much more powerful mode of feedback because they're convinced themselves of their mistake rather than it coming from me (which is my goal).

Related to this is: I always make them second-guess correct answers just as much as incorrect ones. "You sure about that? How do you know? Really? You're sure? Positive?". If I only ask questions to the incorrect answers, students will figure this out and tune out the explanation until I get to the part where they have to change their answer to get to the correct one.

Other strategies:

- make up simpler problems for them to explain before going back to the incorrect one.
- Make up a scenario/problem that contradicts their answer, then we discuss this contradiction
  - ie: if $-3-5=8$, but $3+5=8$ too, then How can both be true?
- start with questions that are basic and that they have confidence in before asking specific questions about the mistake - try to build up to the incorrect answer.
- when investigating an answer, never say anything a kid can say - always find a way for them to explain their reasoning. If they don't know how, ask a simpler question or break the question into pieces.